

Middle School and High School



DESIGN PACKET

NASA Real World: Mathematics (Grades 6-8)

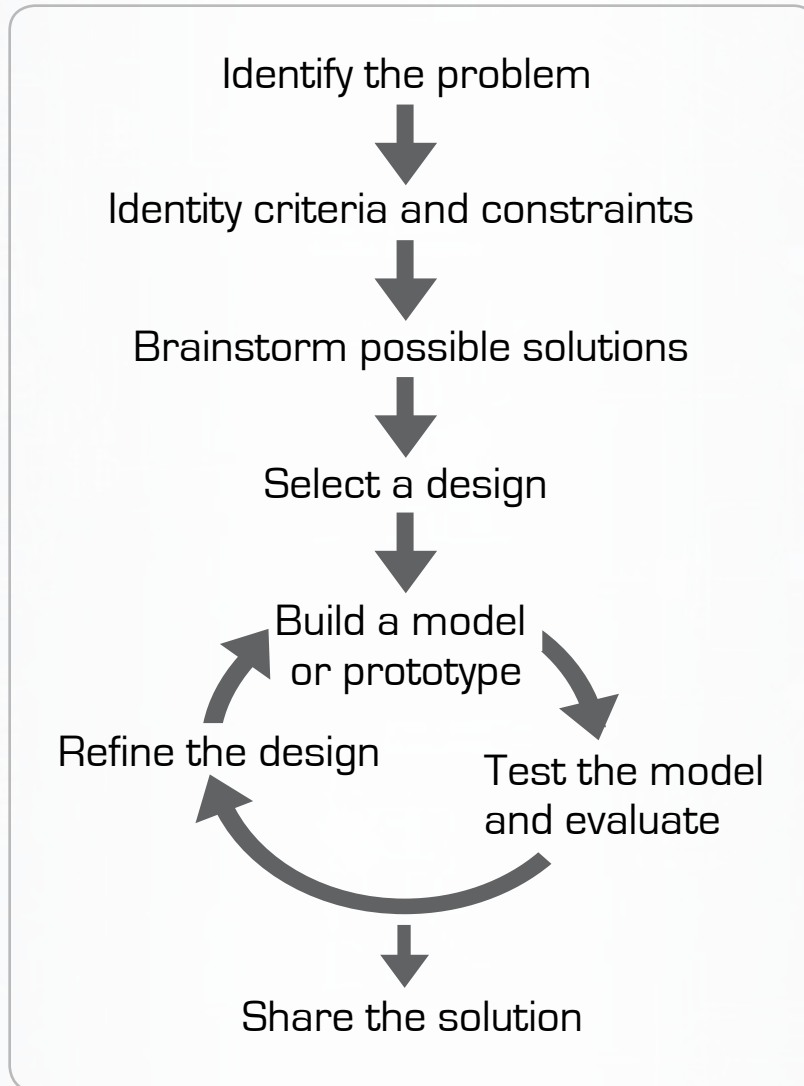
NASA Launchpad (Grades 9-12)

www.nasa.gov/education/nasaclips



Design Process

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Graphic of Design Process



Steps of the Design Process

1. Identify the problem.
2. Identify criteria and constraints.
3. Brainstorm possible solutions.
4. Select a design.
5. Build a model or prototype.
6. Test the model and evaluate.
7. Refine the design.
8. Share the solution.

Step 1: Identify the Problem



- State the problem clearly.

Step 2: Identify Criteria and Constraints

- Identify the conditions that must be met to solve the problem.
- Identify anything that might limit a solution, such as cost, availability of materials, safety.
- Be specific.

Step 3: Brainstorm Possible Solutions



- Consider what others have done to solve this problem and include prior research.
- Generate new ideas for solutions.

Step 4: Select a Design

- Choose two or three of the best ideas from the brainstormed list.
- Make a detailed sketch of each design.
- Label each sketch with dimensions and include the materials needed to build a model.
- Select one design to construct.
- Justify your choice by listing the reasons you selected this design.

Design Sheets

Step 5

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Step 5: Build a Model or Prototype



- Write a detailed procedure for building the model or prototype.
- List the materials actually used to construct the model.
- Follow your procedure and build the model.

Step 6: Test the Model and Evaluate



Test

- Write a hypothesis about your design's performance during testing.
- Use an "If . . . then . . ." format. For example, "If the redesigned model has increased in size (change in the independent variable), then it will fall at a faster speed, (change seen in the dependent variable).
- Decide on a test for the model and try it out.
- Record the results of your tests.

Evaluate

- List the strengths of your design.
- List the weaknesses of your design.
- Discuss what changes, or compromises, in your design (if any) had to be made due to constraints.
- Decide if your design solved the problem identified in Step 1.

Step 7: Refine the Design



- Based on the results of your tests, make improvements on your design.
- Identify the changes that you would make.
- Give reasons for the changes.

Step 8: Share the Design

- Organize your findings. For example, you could make a poster, digital collage, PowerPoint presentation, or short video documentary.
- Present your findings to your teammates for feedback.
- Compare your design to those of your teammates.
- If you were to build this model again, what would you do differently and why?

Design Challenge Evaluation Rubric

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Group Members: _____

Rubric Category	Score
<i>Brainstorm to Identify the Problem and Constraints</i> <ul style="list-style-type: none"> • The problem is identified and explained in detail. • All criteria and constraints are listed and clarified. • Possible solutions are listed from the brainstorming session. • The work others have done to solve the problem is included. 	
<i>Generate Ideas, Possibilities, and Design Choice</i> <ul style="list-style-type: none"> • Two or three ideas are selected from brainstormed list. • Detailed sketches are created for the selected ideas. • Sketches are labeled with dimensions and materials for each component. • One design is selected to construct with reasons for the choice. 	
<i>Build the Model or Prototype</i> <ul style="list-style-type: none"> • Detailed list of materials is included. • Detailed procedures are included and followed. • Materials are handled and stored appropriately. • Safety rules are followed. 	
<i>Test the Model and Evaluate</i> <ul style="list-style-type: none"> • Hypothesis following an “if..., then...” format is developed for the design. • Strengths of the design are listed. • Weaknesses of the design or compromises of the design are listed. • Results are accurately recorded. • Data tables are complete and well organized. • The chosen design effectively addresses the identified problem. 	
<i>Refine the Design</i> <ul style="list-style-type: none"> • Modifications to improve the design are based on test results. • Modifications to the design are documented. • Additional trials are conducted. • Reflections show great insight and understanding of process and goals of project. 	
<i>Share the Design</i> <ul style="list-style-type: none"> • Presentation is well-organized. • Presentation covers all areas of the design process. • Presentation is clearly communicated (verbally or visually) with appropriate data, sketches, graphs or pictures. • Presentation includes contributions from all team members. 	
<i>TOTAL (out of 24 pts possible)</i>	

- 4 (Excellent) = All criteria (procedures, steps, and details) are met or followed with rare mistakes.
 3 (Good) = Most criteria are met with only a few mistakes.
 2 (Fair) = Many criteria are not met and/or there are many mistakes.
 1 (Poor) = Most criteria are not met.
 0 (No effort) = No effort to meet criteria.